# Making a scene
## Representing and annotating enacted interfaces in co-performances using the screenplay

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# Making a scene: representing and annotating enacted interfaces in co-performances using the screenplay

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Automated and connected technologies are increasingly present in everyday life. The concept of co-performance offers a new perspective on artificial agency by understanding artifacts as capable of performing everyday practices next to people. In this pictorial we adopt a lens informed by co-performance, and propose the visual vocabulary of the screenplay as a novel way to represent and annotate co-performances. We highlight conflicts and how they are they are resolved through the enactment of new interfaces in-use. We visually represent and annotate scenes found in data from a study of households living with smart technologies. Using this visual vocabulary reveals the role of time, embodiment, character development and more, in the enactment of interfaces.

***Keywords: co-performance; interface; smart home; screenplay***

## 1 Introduction

Automated and connected technologies are increasingly present in everyday life. In smart buildings, for example, residents and homeowners implement motion-controlled lights, smart thermostats, and connected door locks. These technologies carry out tasks and judgements ('when to heat a room') alongside humans.

This situation presents design researchers and practitioners with a challenge: How do we understand 'the matching of people with things' (Pickering, 2000) when both humans and technologies perform tasks and judgements? And what is an appropriate vocabulary to describe and envision these dynamic roles and relations, and situated interactions?

In this pictorial we adopt the notion of co-performance, as a perspective on the role of artificial agency in everyday life (Kuijer & Giaccardi, 2018). Based in theories of practice, co-performance considers computational artefacts capable of performing practices (everyday activities, tasks and judgements) alongside people.

Although the notion of co-performance is increasingly adopted to study and design roles for automated and connected technologies (e.g., learning systems (Viaene et al., 2021) and intelligent agents (Kim & Lim, 2019), until now, there is no specific vocabulary to describe and envision these co-performances.

In this pictorial, we 1) propose a novel visual vocabulary for representing and studying situated co-performances based on the screenplay, and 2) present insights regarding situated co-performances in smart buildings and how they can be understood as enacted interfaces.

## 2 The lens of co-performance

### 2.1 Human and non-human performers of everyday practices

Co-performance recognizes the doings (or performances) of technologies as relevant to understanding the relation between people and technologies in everyday life (Kuijer & Giaccardi, 2018). Technologies, when acting alongside and without the direct involvement of humans, are part of the unfolding of everyday life, as much as humans. Both humans and artificial performers learn in everyday practice (by being repurposed in new roles and through new product generations).

### 2.2 Judgements, know-how and ideas of appropriateness

In co-performance, everyday practices involve know-how (an idea of appropriate forms of action (Reckwitz, 2002)). Human performers performing practices (e.g., laundry) integrate a know-how of what is appropriate practice ('what is clean laundry?'). For artificial co-performers this know-how exists in their specific embodiments and automations (for example 'washing machine programs') (Kuijer, 2019). This technological know-how is based on an underlying reasoning about what is appropriate practice, applied by designers in the design process.

### 2.3 Crises, conflicts and response

Ideas of appropriate action can be different between human and technological performers (judging 'how much detergent to add to laundry'). When these conflicting judgements manifest in everyday life, this can lead to 'everyday crises of routines' where there is no tested, routinized way of continuing the routine (Reckwitz, 2002). From a human perspective, this means that a technology messes up its judgement of appropriate practice ('the washing machine is wasteful, and adds too much detergent'). Humans might, however, be able to respond to these misjudgments, and repair or correct technological performances. In this way, a new and improved match between human and system performances might be realized (limiting detergent supply in the washing machine), to which technologies again respond (by signaling a detergent supply error).

### 2.4 Interfaces in co-performance

The word 'interface' brings to mind a graphical user interface (GUI): a display, a graphical space, aligned with interactive elements such as physical or virtual buttons. Humans interact with information or machines through this device. This makes sense in the familiar paradigm of user centered design, where researchers and designers are primarily concerned with user experience, control, usability, and information (Bødker, 2006). In sustainability, this often entails eco-feedback (Hargreaves, 2018).

However, what has come to be indicated as 'interface' is just one 'solution to the problem of matching people to things' (Pickering, 2000). Through the lens of co-performance, the matching of people to things does not happen (exclusively) through a GUI. Instead, we suggest that interfaces can be understood as enacted in practice, through human and non-human performances. Specifically, where know-how or ideas of appropriateness conflict, everyday crises in routines occur. Through the resolution of these crises, human and technological performances match. This new matching (or entanglement (Frauenberger, 2019)) of residents and buildings is then a new interface, not designed a priori, but enacted in everyday practice.

## 3 A visual vocabulary for co-performances

### 3.1 Representations of co-performance

Co-performances have been analyzed, represented and envisioned in multiple ways. The work that introduced the concept (Kuijer, 2019), for example, draws primarily on thought experiments on laundry and textual historic analysis of domestic heating (Kuijer & Giaccardi, 2018), tracing the changing roles of humans and technologies through time. These analyses are further detailed by listing the work carried out by technologies, and the work done by human performers, and how this has changed over the past century. In contrast, Viaene et al. (2021) envision and analyze possible future scenarios by bringing together a short fictional text from the perspective of a human and a list of the sequential actions carried out by technologies. Kim and Lim (2019) give form to their 'co-performing agent' by devising a script of text-based conversations on a mobile phone screen. This earlier work reveals that arrangements such as sequences of action, roles, contrasting lists, and the highlighting of different perspectives can be useful ways to represent co-performances.

### 3.2 What a performing arts vocabulary promises for representing co-performances

Interaction design has a long history of engaging with the performing arts; arguably all the way from Grey Walter's cybernetic tortoise (Pickering, 2010), through Laurels 'Computers as Theatre' (1993), to Bleeker and Rozendaal's dramaturgy for devices (2021) and the use of film as design experiment by Lindley et al. (2020). Often, this entails the integration of performative activities (scenarios (Iacucci et al., 2002), roleplay (Boess, 2006), Wizard of Oz) into a design process, to test, explore and communicate ideas. In another line of research, interaction design engages with the concepts, frameworks and language of the performing arts to better understand its object: interactions of people and designed things (Benford et al., 2009). Our focus in this pictorial is closer to this second, analytical line.

Considered from the perspective of everyday practice, co-performances are the doings of people and technologies. They are a sequence of doings performed in response to, and alongside one another. This sequential nature of action is a key feature of the performing arts as well. In a (theatrical) performance, these actions are tied together in a narrative of conflicts, crises, and resolutions. A vocabulary from the performing arts can be helpful in capturing aspects of these sequences that would otherwise be difficult to observe. It makes, for example, explicit the place and time of performances. It captures what people and technologies do, not in isolation, but also how they respond to one another, and how this response is guided by their respective roles and integrated know-how.

### 3.3 The visual vocabulary of the screenplay

Movies tell stories of dialogue, conflicts and resolutions. The screenplay (figure 1.) is a crucial device in the making of a movie. Written by screenwriters, this document provides director, actors and crew with a blueprint to follow during production (Trottier, 2014). Omitting unnecessary details, the screenplay prescribes the events on screen. It is formatted in a specific, and largely standardized way, capitalizing some text and applying different indentations. This visual layout enables readers (film agents, directors, actors) to recognise (at a glance): the length of a scene, involvement of different characters, time elapsed between shots, changes in location, balance between action and dialogue, and key points in a scene (Trottier, 2014, p. 97). Similar to earlier work (Benford et al., 2009), we draw on dramaturgy and its analysis of the structure of performance through space, time, plot and character.

## 4 Ethnographic data in the visual vocabulary of the screenplay

### 4.1 Participating households in smart buildings

Data for this research was collected in early 2022 from 11 smart households, living across the Netherlands. These households contained a variety of smart building technologies. Their implementation was generally motivated by efforts to save energy, or add convenience for residents and rental organizations. The technologies include: automated ventilation system controlled by CO2 and relative humidity sensor readings, thermostats controlling under floor heating, air-to-air-, air-to-water-, and ground-

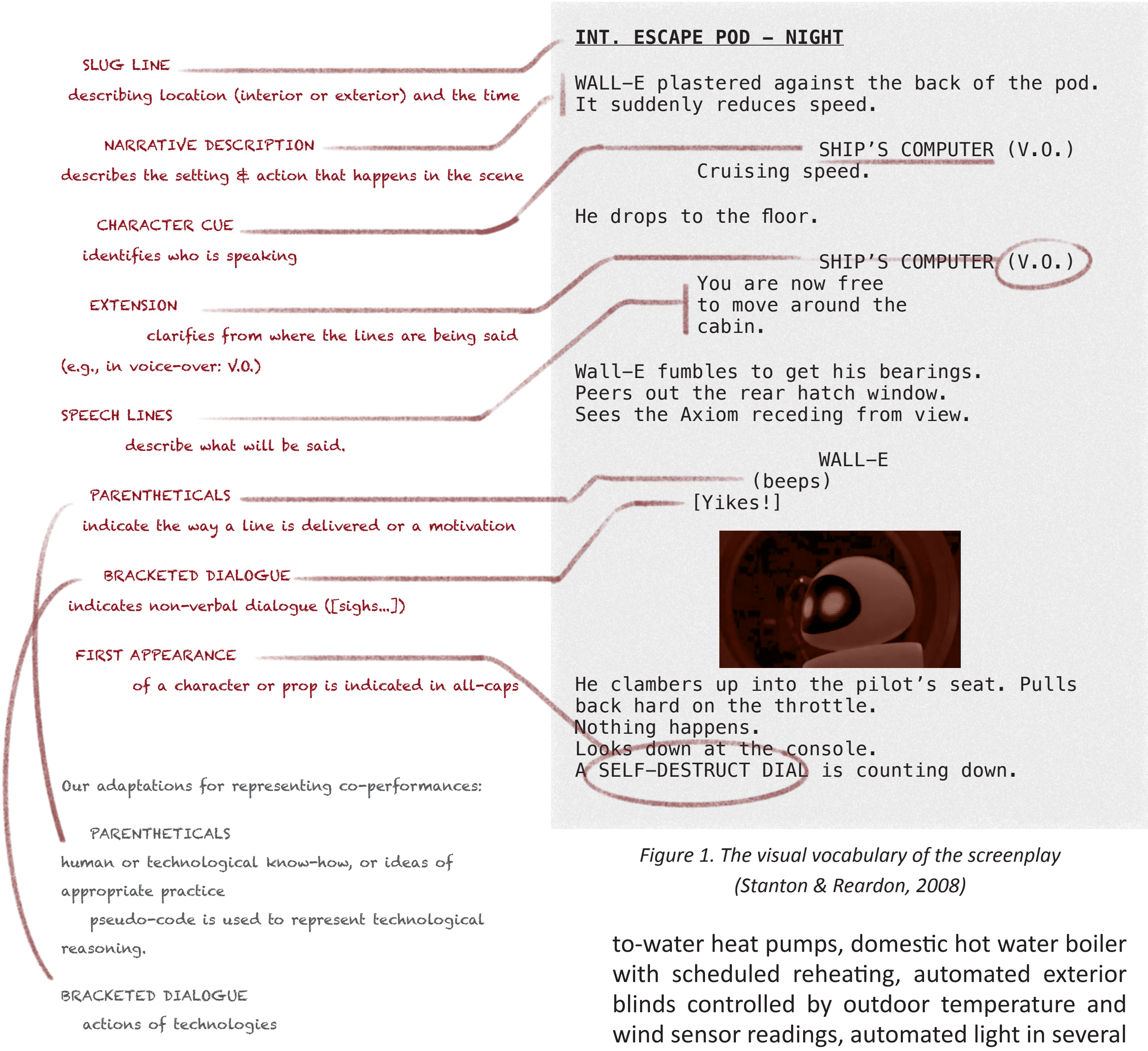


*Figure 1. The visual vocabulary of the screenplay (Stanton & Reardon, 2008)*

to-water heat pumps, domestic hot water boiler with scheduled reheating, automated exterior blinds controlled by outdoor temperature and wind sensor readings, automated light in several areas controlled by movement- and light sensors.

In each household we carried out interviews and a walkthrough, a home tour during which daily routines and technology interactions are re-enacted (Pink & Leder Mackley, 2014) which we captured on video. We processed the data by transcribing interviews and watching the video footage, from which we selected key narratives (or vignettes). A more comprehensive analysis of this data will be presented in forthcoming work.

We selected and reconstructed the narratives by identifying where participants discussed crises and conflicts and how they resolved them. We further selected (and sometimes reordered) statements about these situations and the performers involved in them to build a chronological narrative. These make up, what we have suggested to be an enacted interface, which correspond to the crises and resolutions in a scene in a screenplay.

**The quotes in the scenes below are directly translated from interviews. Parentheticals and technology actions are derived from our own earlier research and knowledge of the field, or from conversations with professionals involved with the households (e.g., social housing technicians). Stills from our video data were often, but not always, recorded at the same moment as the corresponding quotes.**

## 5 Representing and annotating the screenplay

In this section we present and read the resulting screenplays by annotating them. In our readings we recognize six distinct but related aspects of the enacted interfaces.

### 5.1 Responding to crises

Similar to a scene in the typical screenplay, enacted interface 1 presents a story arc, starting with a crisis. For Gemma it starts with a crisis in showering routines. This crisis, stemming from a conflict in know-how of appropriate practices (the projected size of a family living in this house and their needs), then branches out into different inconveniences (e.g., doing the dishes). This crisis is resolved through new routines involving new know-how (planning). In this description, the building requires an adaptation in everyday practices from the residents. It is through this adaptation of performances that a new matching is enacted. This new matching is apparent from the new 'routines' of the boiler which, with residents new showering routines, does not run empty.

### 5.2 Temporal synchronization

The presented interface 1 does not take place in one delimited moment. Instead, it is set in afternoon, evening and night and even stretches across different days. Using the screenplay vocabulary to represent this interface, it becomes clear that events from the past and expectations of the future inform the dynamic of specific technology interactions. Bridging all these different moments (at first glance unrelated from a resident perspective) is the performance of the boiler system. By putting human and technological performances together in one scene, we have made their dynamics readable.

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ENACTED INTERFACE 1: HOT WATER RHYTHMS

INT. BATHROOM OF GEMMA & GIDEON (30'S) - LATE AFTERNOON

GEMMA and GIDEON live in a zero energy house with a family of six. There is
a boiler for domestic hot water with a capacity of 120L. Every 24 hours,
the water is reheated.
                                                   conflict
                    DOMESTIC HOT WATER SYSTEM
               (an average sized family requires <
               120L hot water/day; current hot water
               supply (LOW) time of day (DAY))
          [no reheating]

                    GEMMA (V.O.)
               (make sure all the kids shower on time)
          We really had to get used to the showering. It
          is kind of a puzzle sometimes. Who's going to
          take a shower when?
   crisis One time our youngest had a cold-water shower.

The youngest son KEVIN is standing in doubt about taking a shower.

EVENING

While doing the dishes, Gemma turns the tap low to save water.
elapsed
                    GEMMA (V.O.)
 time     We have to make calculations.

NIGHT


                    HOT WATER SYSTEM
               (an average sized family requires <
               120L hot water/day; current hot water
               supply (LOW); time of day (NIGHT))
          [reheating]

                    GEMMA (V.O.)
               (showering requires planning)
          The boys play soccer on Monday? Then we can take
          a shower on Tuesday.
```

By including the know-how integrated in technological performances in interface 2, we can further explore the role of time in this scene. Enacting this interface involves the layering of multiple (human and technological) time scales. The time scale in which the light automation performs is in minutes, while Michael and Laura's performance spans multiple hours. The enactment of this interface involves a layering of time frames, purposefully synchronized to resolve the lack of light on the landing.

**ENACTED INTERFACE 2: CO-PERFORMING A BEDTIME RITUAL**

**INT. LANDING AT MICHAEL & LAURA'S HOUSE - EVENING**

layer 1 (hours)

MICHAEL and LAURA live in a terraced house with two children and a dog. BOB, their school-age son sleeps in an upstairs room, where a window above the door lets light from the landing in. This automated light turns off when no motion is detected. The detection can be turned off.

LAURA (V.O.)
(Bob needs to sleep well)
Our youngest really likes to sleep with the lights on at the landing upstairs.

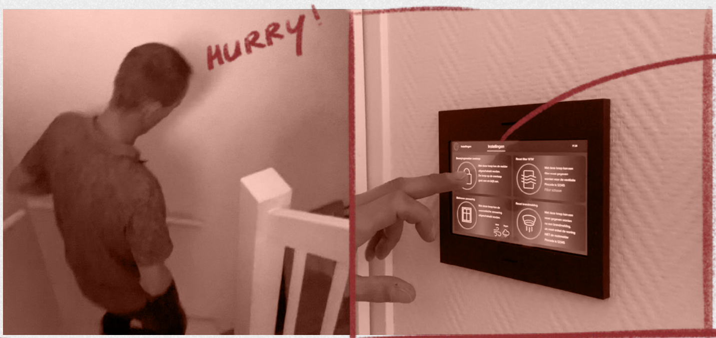
Michael puts Bob to bed.

LIGHT AUTOMATION
(turn off when no-one present; motion detection (ON); motion detected (FALSE))
[timer starts that will turn light off after a few minutes]

know-how

layer 2 (minutes)

LAURA
When we put him to bed, we set it in 'lock', so that it stays on.




lock lights while they're on

**15 MINUTES LATER**

Michael comes back downstairs, quickly puts light automation in lock mode on display in the living room.

LIGHT AUTOMATION
(detection (OFF))
[light stays on]

**HOURS LATER THAT SAME EVENING**

LAURA
And then when we go upstairs later, we put it back.

Michael goes upstairs, puts light in automated mode.

LIGHT AUTOMATION
(detection (ON); motion detected (FALSE))
[timer starts, turns light off]

### 5.3 Bodies

Everyday practices of heating are (from a resident's perspective) to an important degree about realizing bodily comfort. The location of that body clearly matters to the appropriateness of technological co-performance of heating practices. In most cases it does not make sense for an automated heating system to heat unoccupied rooms. In interface 3, the specifics of the technological performance (to which room temperature it responds), create a situation of crisis (working in a cold room). Julia and Micks response to this crisis then involves moving around the house. In this interface, the whole house is the stage, revealed by the sub headers indicating new locations. In addition, interface 3 highlights another embodied aspect of co-performing with this smart building. Enacting a match of residents and building involves careful embodied manipulation (wrist turns) and sensitivities (feeling cold). Performing with smart buildings is a performance where the details of delivery matter.

**ENACTED INTERFACE 3: BALANCING ACT**

**INT. AT JULIA & MICK – UPSTAIRS HOME OFFICE**

JULIA and MICK's house has a central heating system controlled by a thermostat in the living room. This central system delivers hot water to radiators in each room which can be opened and closed with a simple knob.

Mick and Julia are working from home in the room upstairs, like they do on most week days. It is getting cold. Julia goes downstairs.

JULIA (V.O.)
Then we turned up the thermostat.

upstairs


downstairs

**DOWNSTAIRS**

THERMOSTAT
(set temperature > measured temperature in living room)
[central heating on]

changing locations

**BACK UPSTAIRS**

Julia returns to the home office. Mick manipulates the knobs on the radiators.

JULIA
...and then we're upstairs and we realized, oh, it's super-hot now. So we're playing more with the radiators upstairs.

MICK (V.O.)
(turning the knob)
It's off and then just like half a wrist turn and that's enough.

**DOWNSTAIRS**

Meanwhile, the thermostat in the living room stays on.

THERMOSTAT
(set temperature > measured temperature)
[central heating on]

JULIA (V.O.)
Yeah, and then at some point it was like: OK, now it's it seems regulated.

crisis resolved

### 5.4 Props

In interface 4, the enactment involves not just the resident and the smartness in the building. Instead, for Alice and Rudolph, resolving the crisis of a dark utility room involves the installation of a material device, a manual sunshade. This material device is not automated, and thus, in a sense, less 'smart' than building and residents. However, it is in an important sense part of both human performances (being closed by Alice) and technological co-performance (blocking sensor readings). The sun blocking shade is in itself not enough as the interface or the resolution of the scene, but it becomes a part of the matching in co-performance (being rolled down), and thus plays a critical role in 'making the interface work'.

**ENACTED INTERFACE 4: BRIGHTENING UP**

**<u>INT/EXT. UTILITY ROOM OF ALICE AND RUDOLPH (40'S) – LATE AFTERNOON</u>**

ALICE and RUDOLPH rent a new, modern terraced house from a social housing corporation. The utility room (or scullery, a small room that has a door to both the living room and the garden) is set up with automated lighting by the corporation.

ALICE (V.O.)<br>
(light is required for utility room activities, automated light is convenient)<br>
It's great you can walk in with full hands and don't have to think about something.

Alice walks in carrying a laundry basket.

LIGHT AUTOMATION<br>
(for convenience and energy savings: turn lights on when someone is present (TRUE) AND when light levels are insufficient(FALSE))<br>
[light remains off]

crisis

ALICE<br>
But it doesn't turn on when it is somewhat light. So you're looking inside a dark cabinet.

**MONTHS LATER**

Alice and Rudolph have installed a MANUAL SUNSHADE that shades the sensor when closed.

alice's actions

ALICE<br>
Now we have added some extra shading which we roll down, so the automatic lighting turns on.

less light for more light

tech actions

LIGHT AUTOMATION<br>
(turn lights on when someone is present (TRUE) AND when light levels are insufficient(TRUE))<br>
[light turns on]

## 5.5 Cameos

The format of the screenplay enables the recognition of new appearances. In interface 5, the dog is critical for Louise in understanding technological performances and performing with the under floor heating. Different from the auxiliary role of the manual sunshade in interface 4, the dog is herself a performer on the scene. She performs practices (drinking, warming up) which are meaningful to herself. They are also meaningful to the matching of Louise's performances (of heating and placing carpets) with the co-performance of heating by the smart building. In this way, the dog's performances and Louise's performances become entangled.

**ENACTED INTERFACE 5: A DOGS GUIDE TO HOME COMFORT**

**INT/EXT. AT LOUISE (70'S) – EARLY MORNING**

LOUISE lives with her dog DAISY in a terraced house. On the ground floor, this house has under floor heating. When Louise moved into this house, this under floor heating did not work right away. But then, on a cold morning the repairs finally start to have an effect.

Daisy is released from the dog crate in the living room where she sleeps.

DAISY (DOG) first appearance

(air is much warmer, thirst)

[runs to water]

LOUISE (V.O.)

What was really funny, when she came out of the dog crate, she immediately ran for the water. She normally never does that, so yeah, I think she was thirsty.

**LATER**

Daisy's behavior tells Louise where the under floor heating pipes are located. Since, she has shuffled around the living room without shoes to more precisely tell where to be for the most warmth.

LOUISE (V.O.)

Yes, the dog was lying down around this spot.

## 5.6 Learning

In the screenplay, parentheticals allow us to recognize the know-how of characters involved in their actions. In interface 6 the parentheticals motivating Gideon's speech lines are changing over the course of the scene. Where Gideon's first response (never intending to interact with the convector) indicates a flexibility towards the temperature in the bedroom and a lack of interest in heating this room, his second response involves an acceptance of nuisance. Like movie characters and their journey of transformation from resistance to acceptance, this can be described as a form of learning. This enacted interface is Gideons adaptation of routines and know-how to automated systems, and in this way his acceptance of their leverage in shaping everyday life.

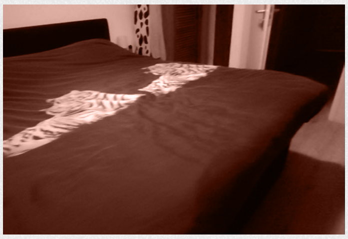
**ENACTED INTERFACE 6: INTERRUPTIONS**

**INT. BEDROOM OF GEMMA AND GIDEON (30'S) – NIGHT**

Fans in the bedroom convector can move warm or cool air quicker through the room. This system is automated in such a way that a fluctuation in temperature can cause the fans to turn on, in order to cool the room to the set temperature. This can happen anytime of day.

GIDEON (V.O.)
(sleeping can happen in any temperature, extra cooling or heating is not required)
We never turn that thing on!

changing parentheticals (character transformation)



GEMMA and GIDEON asleep

GIDEON
But sometimes it starts cooling by itself. Starts to blow really loud.

CONVECTOR
(temperature is too high AND temperature of convector is low)
[starts cooling with fan]

responding to each other

GIDEON
(brief waking moments are acceptable to resolve nuisances)
And then we quickly press the buttons

Gideon wakes up, quickly turns off the cooling.

CONVECTOR
[stops cooling with fan, paused fan activity for factory set timespan]

GIDEON
and we can go back to sleep.

## 6 Concluding reflections

In this pictorial, we have represented and annotated interview data from a study of 11 households living with smart buildings. Our analysis focused on conflicts between what residents do and find appropriate and what technologies do, and how these conflicts are resolved through the enactment of new interfaces in the use phase. Using this visual vocabulary revealed that these enacted interfaces: respond to crises (1), involve time (2), and bodies (3); involve props (4) and cameos (5); and involve learning as part of the resolution (6). In this section, after reflecting on our use of the screenplay, we conclude that taken together, these aspects form the starting points for a way of thinking about interfaces.

### 6.1 The screenplay for reading co-performances

In this pictorial, we found that the screenplay turns out to be a novel effective vocabulary for reading the interfaces. Our own data from smart buildings, including varying scales of time and place, lends itself well to representing enactments. This vocabulary and its associated dramaturgical approach offers a range of sensitizing concepts (such as characters, props, and time) which we hope makes designers aware of enacted interfaces, in addition to or replacing the ones designed in the technologies.

Furthermore, this vocabulary connects the concept of co-performance and enacted interfaces with smart technologies to a wide range of different interpretations and readings from the performing arts which we have not elaborated here. Future work could draw on concepts like stage (Goffman, 1974), transitions (Benford et al., 2009) and spectators (Sauter, 2004).

The screenplay could be further adapted as a tool not only for analysis, but also for design. In a parallel to the widespread use of storyboards (van der Lelie, 2006), roleplaying (Boess, 2006), and scenarios (Brandt & Grunnet, 2000), this has several potential benefits. It might enable designers to express, and document envisioned enacted interfaces. It might also help anticipation and inquiry into 'what might be' and thus help designers identify opportunities, potential challenges, and issues early on.

There are also limitations to the screenplay. As a representation it excludes many aspects. In our case, for example, we have not engaged with the many (corporate) interests and interdependencies introduced when technologies are connected to the internet (Redström & Wiltse, 2019). Finally, when used for anticipation, the screenplay is inherently limited in predictive power, as performance is always contingent upon the situation.

### 6.2 Enacted interfaces and interaction design

Reading enacted interfaces through the vocabulary of the screenplay raises questions for research and design. From a perspective of co-performance, situated interactions are hard to predict and contingent upon the many factors (e.g., cameos and props) present in everyday life where residents live with smart technologies.

While the know-how integrated in the performances of smart technology often makes sense from a generic point of view (e.g., average daily needs of domestic hot water), our reading reveals that this reasoning led to crises in routines. Thinking about enacted interfaces as resolutions to these crises might be helpful in coming up with different forms of technologically-mediated "responsiveness" (Giaccardi & Redström, 2020) (e.g., technologies that learn in use).

It appears that use time (i.e., the period when the technology is used in everyday life, in contrast to design time) is critical to enacting interfaces. It takes time for residents and smart building to work out new matches, and get further entangled. This suggests a more active role for designers after design time; helping, guiding and learning from newly enacted interfaces.

While crises in everyday routines appear to be good starting points for the enactment of new interfaces, they also present nuisance to the residents. There might be a way to engender crises in a way that is productive, while being less distressing. For example, a boiler could introduce a minor crisis in routines by only slightly lowering water temperature when coming close to the limits of domestic hot water, rather than creating larger crises when the boiler runs completely empty.

## 7 Conclusion

In this pictorial, we have proposed the novel visual vocabulary of the screenplay. We have represented and annotated enacted interfaces in the co-performance of residents and smart buildings in this vocabulary. We hope that this serves a conversation about the roles, capacities, and appropriateness of the technological co-performances that we design (for), particularly in the domain of automated and connected systems that are present in everyday life.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